REMARKS

The informality noted in the "Brief Description of the Drawings" at page 6, line 29, of the specification has been corrected ("Figure 1B" changed to --Figure 2B--). In addition, other informalities in the specification have been corrected as noted in the section entitled "Marked Version Of Specification Showing Location Of Changes" following the Remarks.

Claim Rejections Under 35 USC 102(e)

Claims 1, 2, 5-12, 17, 18, 25-27 and 31-32 have been rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-24 of US Patent No. 5,962,921.

Claims 1, 2, 5-12, 17, 18, 25-27 and 31-32 have been rejected under 35 USC 102(e) as being anticipated by Fjelstad et al. (US Patent 6,086,386).

Claims 1, 2, 5-12, 17, 18, 25-27 and 31-32 have been rejected under 35 USC 102(e) as being anticipated by Farnworth et al. (US Patent No. 5,962,921) or Farnworth et al. (US Patent No. 5,756,370).

Claims 1, 2, 5-12, 17, 18, 25-27 and 31-32 have been rejected under 35 USC 102(b) as being anticipated by Barabi et al. (US Patent No. 5,629,837).

Summary of the Invention

Independent claims 1, 6 and 12 are directed to an interconnect 10 (Figure 1) for testing a semiconductor component 18 (Figure 3B) having a bumped contact 16 (Figure 3B). As shown in Figures 3A and 3B, the interconnect 10 includes a substrate 12B, and a contact 14B on the substrate 12B for electrically engaging the bumped contact 16. The contact 14B includes a recess 20B in the substrate 12B, and a plurality of leads 22B cantilevered over the recess 20B configured to electrically engage the bumped contact 16. As

shown in Figure 3B, the leads 22B have a shape that matches a topography of the bumped contact 16. In addition, the leads 22B include projections 28B for penetrating the bumped contact 16. As shown in Figure 3D, the leads 22B include an outer layer 46B formed of a material that is non-bonding relative to the bumped contact 16.

As shown in Figure 3A, the contact 14B also includes a conductive connecting segment 40B on the substrate 12B which electrically connects the leads 22B to one another. As also shown in Figure 3A, the connecting segment 40B can encircle a periphery of the recess 20B. As shown in Figure 3C, the interconnect 10 also includes conductive vias 42B and a contact pad 38B formed on a backside of the substrate 12B in electrical communication with the connecting segment 40B. The conductive via 42B and the contact pad 38B provide a conductive path from test circuitry to the contact 14B.

Independent claim 25 is directed to a test system 100 (Figure 9A) that includes die level interconnect 10A. The test system 100 includes a carrier 80 configured to retain the component 18A, which can comprise a singulated die or package. The test system 100 also includes test circuitry 98 configured to apply test signals through the interconnect 10A to the component 18A.

Independent claim 31 is directed to a test system 100W (Figure 10) that includes a wafer level interconnect 10W. The test system 100W includes a test apparatus 96W, such as a wafer prober, having spring loaded electrical connectors 104 configured to electrically engage the contact pads 38W on the interconnect 10W. The test system 100W also includes test circuitry 98 configured to apply test signals through the interconnect 10W to the wafer 102.

Double Patenting Rejections Over Farnworth et al. ('921)

The double patenting rejections over Farnworth et al. ('921) are traversed, as the present claims are submitted to be unobvious over the claims of Farnworth et al. ('921).

Specifically, the claims of Farnworth et al. ('921) are directed to an interconnect for a semiconductor component having a contact bump that includes a contact that is fundamentally different than the contact presently claimed.

Claims 1-6 and 11-14 of Farnworth et al. ('921) define the interconnect with the contact member 22F of Figure 7. The contact member 22F includes a blade 48F which is stated in claims 1 and 11 to comprise "a portion of the substrate". The blade 48F in Farnworth et al. ('921) is solid rather than being flexible as presently claimed. As such, the blade 48F in Farnworth et al. ('921) is not "cantilevered over the recess configured to support the bumped contact within the recess and to move within the recess by a distance sufficient to accommodate variations in a size, a shape or a planarity of the bumped contact" as with the leads of the presently claimed interconnect. (Antecedent basis for this recitation is provided at page 12, lines 1-5 of the specification.) In addition, the blade 48F in Farnworth et al. ('921) does not have a selected "spring constant" as with the leads of the presently claimed interconnect.

Claims 7-10, 15-20 and 24 of Farnworth et al. ('921) define the interconnect with the contact member 22 of Figures 3-3C. As shown in Figure 3C, the contact member 22 comprises a recess 32 covered by a conductive layer 34. However, as argued above, there are no flexible leads configured to move within the recess to accommodate variations in the bumped contact, and having a selected spring constant, as with the leads of the presently claimed invention.

Claims 21-23 of Farnworth et al. ('921) define the interconnect with the contact member 22G of Figures 4A-4D. The contact member 22G includes multiple peripheral edges 38G, 38GG for penetrating the contact bump. However, as argued above, there are no flexible leads configured to move within the recess to accommodate variations in the bumped contact, and having a selected spring constant, as with the leads of the presently claimed invention.

In view of these fundamental differences, the present claims are submitted to be unobvious over the claims of Farnworth et al. ('921).

35 USC §102(e) Rejections Over Fjelstad et al. ('386)

The rejections under 35 USC §102(e) over Fjelstad et al. ('386) are traversed, or in the alternative submitted to have been overcome by the amendments, as the independent claims define features of the present interconnect that are not taught or suggested by Fjelstad et al. ('386). Further, the contacts in Fjelstad et al. ('386) are fundamentally different than the contacts of the present interconnect, such that the interconnect "taken as a whole" is unobvious over the connector 10 of Fjelstad et al. ('386).

In this regard, the connector 10 of Fjelstad et al. ('386) includes projections 28 over a hole 27 in a sheet like element 24. These projections 28 were stated in the Office Action to be equivalent to the present claimed cantilevered leads. However, the projections 28 are only about 50 microns long (column 10, lines 19-20). The projections 28 are designed to penetrate the bumped leads 46 (column 10, lines 60-62), but are not designed to move within the hole 27 to accommodate variations in the size, shape or planarity of the bumped leads 46. Rather, as shown in Figure 3 of Fjelstad et al. ('386), the sheet like element 24 is pivoted on posts 23 which provide a standoff space 57. As stated at column 13, lines 39-43, the sheet like element 24 resiliently deforms into the standoff space 57. The resilience of the sheetlike element 24 maintains contact between the protruding portions 28 of the contact tab 21 and the bump lead 46 (column 13, lines 53-55), while the projections wipe against the bump lead 46 (column 13, lines 29-31).

Thus, while the projections 28 of Fjelstad et al. ('386) may be cantilevered over a hole 27, they are not constructed to function in the manner of the present leads 22B (Figure 3B) to move into a recess 20B (Figure 3B) for accommodating

variations in the contact bumps 16. Further, the projections 28 of Fjelstad et al. ('386) do not have a selected spring constant as with the presently claimed leads 22B (Figure 3B). The present spring constant allows the leads 22B (Figure 3B) to move into the recess 22F (Figure 3B), and provides a force for pressing the projections 28B (Figure 3B) into the bumped contact 16. Although the projections 28 of Fjelstad et al. ('386) may inherently have a spring constant, it would be selected to be large enough for the projections 28 to penetrate the bump leads 46.

Further, amended independent claims 6 and 31 state that the leads have "a shape that substantially matches a topography of the bumped contact" (See Figure 3B). Independent claim 12 states that the leads have "a radius of curvature substantially equal to a radius of the bumped contact". This curved shape increases the contact area between the leads and the bumped contact. The projections 28 of Fjelstad et al. ('386) of Fjelstad et al. ('386) appear to be generally planar, rather than curved as with the presently claimed leads. The present curved shape is thus not inherently present. Further, as the projections 28 are relatively small (e.g., 50 microns long), a relatively small area is provided for contacting the bump leads 46.

In view of these differences the amended claims are submitted to be both novel and unobvious over Fjelstad et al. ('386).

35 USC §102(e) Rejections Over Farnworth et al. ('921)

The rejections under 35 USC §102(e) over Farnworth et al. ('921) are traversed. As previously argued with respect to the double patenting rejections, Farnworth et al. ('921) defines a contact having stationary blades (e.g., 48F-Figure 7). In addition, the blades in Farnworth et al. ('921) are not "cantilevered over the recess configured to support the bumped contact within the recess and to move within the recess by a distance sufficient to accommodate variations in

a size, a shape or a planarity of the bumped contact" as with the leads of the presently claimed interconnect. Further, the blade 48F in Farnworth et al. ('921) does not have a selected "spring constant" as with the leads of the presently claimed interconnect.

35 USC §102(e) Rejections Over Farnworth et al. ('370)

The rejections under 35 USC §102(e) over Farnworth et al. ('370) are traversed, or in the alternative submitted to have been overcome by the amendments to the claims. Farnworth et al ('370) is directed to a compliant contact system that includes metal traces 16 (Figure 1G) cantilevered over a pit 32 (Figure 1G). In Farnworth et al. ('370) there is only one pit 32 and only one lead 16 for each bond pad 25 (Figure 5) or bumped bond pad on the die 27. In contrast the presently claimed contact 14B includes a recess 20B (Figure 3B) for each bumped contact 16, and a plurality of cantilevered leads 22B (Figure 3B) for each bumped contact 16. Further, amended independent claims 1, 25 and 31 state that the recess has "a size approximately equal to that of the bumped contact". (Antecedent basis for this recitation is provided on page 11, lines 29-31 of the specification).

With a plurality of cantilevered leads 22B, a larger area is provided for supporting the bumped contact 16 such that the recess 20B can be larger and larger size variations can be accommodated. In addition, a larger surface area is provided by the leads 22B for electrically engaging the bumped contact 16.

Further, Farnworth et al. ('370) does not teach a projection 28B (Figure 3B) on the leads 16 configured to penetrate the bumped contact. Rather, for bumped bond pads Farnworth et al. ('370) teaches a flat surface on the metal traces (column 2, lines 19-21). Although Farnworth et al. ('370) teaches a rough textured surface (column 2, lines 22-25) for penetrating the bond pads, a rough textured surface

is not equivalent to a projection as presently claimed, and would not function in the same manner.

Still further, Farnworth et al. ('370) does not teach the presently claimed feature of independent claims 6 and 12 of a curved shape for the leads 16. Rather as shown in Figure 1F of Farnworth et al. ('370), the leads 16 are generally planar in shape. As previously argued, the presently claimed curved shape increase the area of contact for supporting and electrically engaging the bumped contacts 16.

In view of these fundamental differences the amended claims are submitted to be both novel and unobvious over Farnworth et al. ('370).

35 USC §102(e) Rejections Over Barabi et al. ('837)

The rejections under 35 USC §102(e) over Barabi et al. ('370) are traversed, or in the alternative submitted to have been overcome by the amendments to the claims. As shown in Figure 3A of Barabi et al. a button contact 19 includes support arms 49, 50 cantilevered over openings 59 in an insulator backing 55. In addition, the button contact 19 includes projections 51 for contacting a contact surface on a leadless IC device 11.

Barabi et al. ('370) teaches a single support arm 49 for the contact surface on the IC device, rather than a plurality of cantilevered leads 22B for each bumped contact 16 as presently claimed. (The other support arm 50 contacts the circuit contacts 17 on PC board 31, such that it is not designed to support the contact surface on the leadless IC device 11.) As previously argued with multiple cantilevered leads more support and an increased surface area is provided.

Further, although Barabi et al. ('370) teaches openings 59 in an insulator backing 55, there is no teaching of the size of the openings being approximately equal to bumped contacts 16 as presently claimed in independent claims 1, 25 and 31. Still further, there is no teaching in Barabi et al.

('370) of the presently claimed feature of independent claims 6 and 12 of a curved shape for the leads 16.

In view of these fundamental differences the amended claims are submitted to be both novel and unobvious over Barabi et al. ('370).

CONCLUSION

In view of the above amendments and arguments, favorable consideration and allowance of claims 1, 2, 5-12, 17, 18, 25-27, 31 and 32 is requested. An Information Disclosure Statement is being filed concurrently with this Amendment. Should any issues remain, the Examiner is asked to contact the undersigned by telephone.

DATED this 17th day of September, 2001.

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September 17, 2001
Date of Signature

Stephen A. Gratton
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Marked Version Of Specification Showing Location Of Changes

On page 6,

line 29, change "Figure 1B" to --Figure 2B--.

On page 13,

line 28, change "46A" to --46B--;

line 31, change "46A" to --46B--;

line 33, change "46A" to --46B--.

On page 24,

line 30, change "test circuitry 100" to --test circuitry 98--.

Marked Version Of Amended Claims Showing Changes

1. (amended) An interconnect for testing a semiconductor component having a bumped contact comprising:

a substrate; and

a contact on the substrate configured to electrically engage the bumped contact, the contact comprising a recess in the substrate having a size approximately equal to that of the bumped contact, and a plurality of flexible leads cantilevered over the recess configured to support the bumped contact within the recess and to move within the recess by a distance sufficient to accommodate variations in a size, a shape or a planarity of the bumped contact, each lead having a selected spring constant and at least one projection configured to penetrate the bumped contact.

[to move within the recess to electrically engage a bumped contact on the component, each lead comprising at least one projection for penetrating the bumped contact, and a non-bonding outer layer for preventing bonding of the lead to the bumped contact.]

2. (amended) The interconnect of claim 1 further comprising a connecting segment substantially encircling a periphery of the recess configured to electrically connect the leads to one another.

[wherein the leads comprise a deposited and patterned metal layer on the substrate.]

5. (amended) The interconnect of claim 1 wherein the recess has four sides and the plurality of leads comprise four leads on the four sides.

[leads have a shape that matches a topography of the bumped contact.]

6. (amended) An interconnect for testing a semiconductor component having a bumped contact comprising:

a substrate;

a recess in the substrate; and

a plurality of flexible leads on the substrate cantilevered over the recess [and] configured to electrically engage the bumped contact and to move within the recess [to electrically engage a] by a distance sufficient to accommodate variations in a size, a shape or a planarity of the bumped contact [on the component], each lead having a cantilever length, a width, a thickness and a modulus of elasticity selected to provide a desired spring constant, and a shape that substantially matches a topography of the bumped contact.

[; and]

[a conductive connecting segment proximate to the recess electrically connecting the leads to one another.]

7. (amended) The interconnect of claim 6 wherein each lead includes at least one projection configured to penetrate the bumped contact.

[the connecting segment encircles a periphery of the recess.]

8. (amended) The interconnect of claim 6 further comprising a connecting segment on the substrate electrically connecting the leads to one another.

[a conductive via in the substrate in electrical communication with the connecting segment.]

9. (amended) The interconnect of claim 6 wherein each lead comprises an enlarged portion [attached to] on the substrate and a terminal portion cantilevered over the recess for contacting the bumped contact.

10. (amended) The interconnect of claim 6 wherein [the] each lead[s] comprises a metal selected from the group consisting of tungsten, titanium, nickel, platinum, iridium, or vanadium.

11. (amended) The interconnect of claim 6 wherein the recess has four sides and the plurality of leads comprise four leads on the four sides.

12. (amended) An interconnect for testing a semiconductor component having a bumped contact comprising:

a substrate;

a recess in the substrate; and

a plurality of leads on the substrate cantilevered over the recess and configured to support and to electrically engage the bumped contact within the recess, and to move in a z-direction within the recess to accommodate variations in a height or a diameter of the bumped contact, [electrically engage a bumped contact on the component, the] each lead[s] having a [curved shape] radius of curvature [which] substantially [matches a topography] equal to a radius of the bumped contact.

17. (amended) The interconnect of claim 12 wherein each lead has a cantilevered length, a width and a thickness [selected] configured to provide a desired spring constant.

18. (amended) The interconnect of claim 12 wherein each lead has an enlarged portion [attached to] on the substrate and a terminal portion cantilevered over the recess for contacting the bumped contact.

25. (amended) A system for testing a semiconductor component having a bumped contact comprising:

a carrier for retaining the semiconductor component;

an interconnect on the carrier comprising a substrate, a recess in the substrate having a size approximately equal to that of the bumped contact, and a plurality of leads cantilevered over the recess configured to electrically engage the bumped contact and to move within the recess [to electrically engage a] by a distance sufficient to accommodate variations in a size, a shape or a planarity of the bumped contact [on the component], each lead comprising at least one projection [for penetrating] configured to penetrate the bumped contact; and

[, and a non-bonding outer layer for preventing bonding of the lead to the bumped contact; and]

a test circuitry in electrical communication with the leads [for] configured to apply [ing] test signals to the component.

26. (amended) The system of claim 25 wherein [the] each lead includes a non bonding outer layer and has a radius of curvature substantially equal to a radius of the bumped contact.

[s have a curved shape which substantially matches a topography of the bumped contact.]

27. (amended) The system of claim 25 wherein the semiconductor component comprises an element selected from the group consisting of semiconductor dice, semiconductor packages and semiconductor wafers.

31. (amended) A system for testing a semiconductor component having a bumped contact comprising:

a [wafer prober] testing apparatus;

an interconnect mounted to the [wafer prober] testing apparatus comprising:

a substrate;

a recess in the substrate having a size approximately equal to that of the bumped contact; and

a plurality of leads on the substrate configured to electrically engage the bumped contact, each lead cantilevered over the recess and configured to move within the recess [to electrically engage a] by a distance sufficient to accommodate variations in a size, a shape or a planarity of the bumped contact [on the component], each lead having a cantilever length, a width, a thickness and a modulus of elasticity selected to provide a desired spring constant, and a shape substantially matching a topography of the bumped contact; and

[a conductive connecting segment proximate to the recess electrically connecting the leads to one another; and]

a test circuitry in electrical communication with the connecting segment.

32. (amended) The system of claim 31 wherein the connecting segment substantially encircles a periphery of the recess and electrically connects the leads.

[leads have a curved shape that substantially matches a topography of the bumped contact.]